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Characterization Analysis Report

Surface Vessel Bilgewater/Oil Water Separator

Section 1.0 – Introduction and Table of Contents

August 2003

DRAFT

CHARACTERIZATION ANALYSIS REPORT

*SURFACE VESSEL BILGEWATER/
OIL WATER SEPARATOR (OWS)*

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SECTION 1.0 – INTRODUCTION

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LIST OF ACRONYMS

BCC	Bioaccumulative Contaminant of Concern
BOD	Biochemical Oxygen Demand
CAS	Chemical Abstract Services; Refers to the CAS number, a unique numeric identifier for each chemical constituent. Constituents without CAS numbers, that were identified in vessel discharges, were assigned proxy CAS numbers, e.g., classicals and class based constituents.
ChAR	Characterization Analysis Report
CH3D	Curvilinear-grid Hydrodynamics 3D model
CHT	Collection, Holding, and Transfer
CI	Compression Ignition
COC	Constituent of Concern
DFM	Diesel Fuel Marine
DoD	Department of Defense
EEA	Environmental Effects Analysis
EEAR	Environmental Effects Analysis Report
EOMZ	Edge of Mixing Zone (35 m from EOP)
EPA	United States Environmental Protection Agency
FIAR	Feasibility Impact Analysis Report
HEM	Hexane Extractable Material
MPCD	Marine Pollution Control Device
NAVSEAINST	Naval Sea Systems Command Instruction
NIS	Non-Indigenous Species
OCM	Oil Content Monitor
OPNAVINST	Operating Naval Instruction
OWHT	Oily Waste Holding Tank
OWS	Oil Water Separator
TSS	Total Suspended Solids
UF	Ultrafiltration
UNDS	Uniform National Discharge Standards
WQC	Water Quality Criteria

1.0 INTRODUCTION

The discharge characterization report is organized by representative vessel. All results are indicative of, and applicable to, the representative vessel class, as well as to all other vessels within the group. Any deviations are specifically noted. For each vessel group the identified marine pollution control device (MPCD) options are characterized in respect to physical parameters, chemical data, field data, descriptive data and discharge generation.

Surface vessels produce bilgewater when wastewater accumulates in the bilge area. The bilge area is the lowest inner part of a vessel hull that holds water drained from upper decks and inner spaces (40 CFR 1700.4).

The composition of bilgewater varies among vessels. Certain waste streams, including steam condensate, boiler blowdown, drinking fountain water, and sink drainage located in various machinery spaces can drain into the bilge. Leaks and spills from the ship's propulsion and auxiliary systems, as well as precipitation and greenwater, can also enter the bilge.

On some vessels, the oily and non-oily machinery wastewater drain to segregated collection systems. For those vessels with a non-oily machinery wastewater system, it is considered a separate discharge and will be addressed in the non-oily machinery wastewater characterization report.

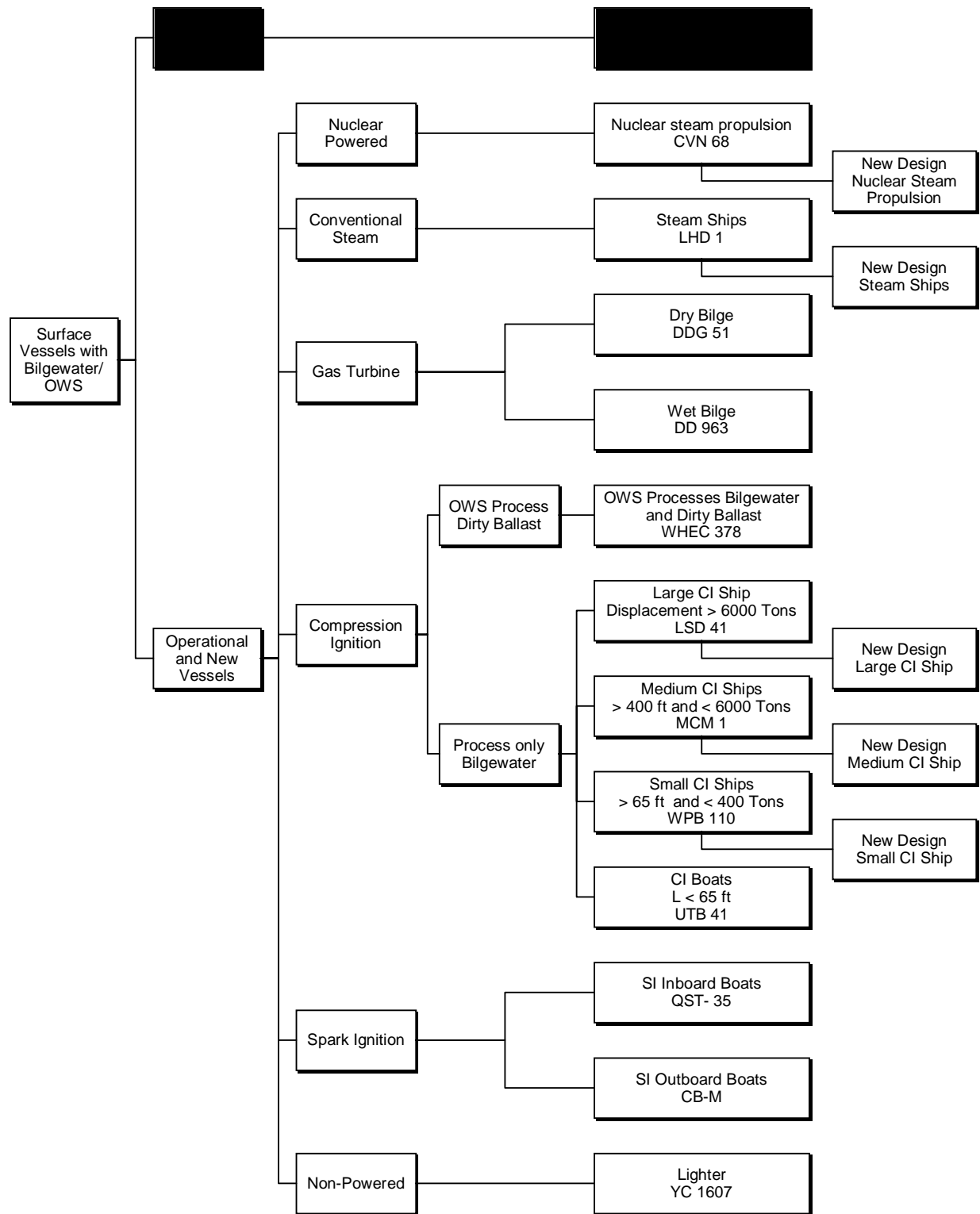
1.1 VESSEL GROUPS

To facilitate the feasibility and environmental effects analyses (EEA), and due to the large number of vessel classes and designs, Armed Forces vessels were sorted into vessel groups according to similarities in engineering and discharge characteristics. Vessels that produce bilgewater/OWS discharge were sorted into vessel groups using a tiered process. The discriminating tiers were: surface vessels that produce bilgewater/OWS discharge; vessel operational status; type of propulsion system; bilgewater and dirty ballast processing; vessel size; type of bilge; engine placement; and new designs. A representative vessel class was selected for each vessel group. For complete details for each vessel group, see the *Vessel Grouping and Representative Vessel Selection for Surface Vessel Bilgewater/Oil-Water Separator Discharge* (Navy and EPA, 2001a).

The specific vessel classes that were selected to represent each vessel group are (Figure 1-1):

- Non-operational vessels: LKA 113
- Nuclear Steam Propulsion: USS NIMITZ (CVN 68)
- Conventional steam ships: USS WASP (LHD 1)
- Vessels with Gas turbine with dry bilge: USS ARLEIGH BURKE (DDG 51)
- Vessels with Gas turbine with wet bilge: USS SPRUANCE (DD 963)
- Diesel ships OWS process bilgewater and dirty ballast: WHEC 378
- Large diesel ships (6000 tons of displacement or more): USS WHIDBEY ISLAND (LSD 41)
- CI vessels process only bilgewater with displacement between 400 and 4000 tons: MCM 1
- Small diesel ships (65 feet or more in length and under 400 tons of displacement): WPB 110
- CI boats under 65 ft: UTB 41
- SI inboard vessels: QST 35
- SI outboard vessels: CB-M
- Non-powered vessels: YC 1607

Figure 1-1. Bilgewater Vessel Groupings



1.2 MARINE POLLUTION CONTROL DEVICES

Potential marine pollution control devices (MPCDs) were identified for the discharge and were combined by similar operation into option groups. As described below, there are two general types of MPCD for surface vessel bilgewater, primary treatment and secondary treatment, in addition to collection, holding, and transfer (CHT). The MPCD option groups identified in the FIAR are listed below.

- Gravity Coalescer
- Gravity Coalescer plus filter media
- Gravity Coalescer plus membrane filtration
- Centrifuge
- Centrifuge plus filter media
- Centrifuge plus membrane filtration
- Hydrocyclone
- Hydrocyclone plus filter media
- Hydrocyclone plus membrane filtration
- Evaporation
- CHT

For the surface vessel bilgewater discharge, the effluent from four MPCD option groups, some of which are a combination of primary and secondary devices, are characterized. These MPCD option groups are listed below.

- Primary Treatment
- Primary Treatment plus filter media
- Primary Treatment plus membrane filtration
- CHT

Characterization data are presented by MPCD option group for each vessel group.

1.2.1 Primary Treatment

Primary treatment MPCDs can be used for the initial treatment of surface vessel bilgewater. Gravity coalescers, hydrocyclones, and centrifuges are feasible primary treatment devices for this discharge. These three devices were assumed to have the same performance while treating bilgewater because they rely on the same basic principles (Navy and EPA, 2002a). Gravity coalescers are used aboard most Armed Forces vessels for primary bilgewater treatment. Therefore, gravity coalescer characterization data will be used to represent performance of primary treatment MPCDs.

Evaporation, *in situ* biological treatment, and oil absorbing socks are also examples of potential primary treatment MPCDs. However, effluents from these MPCDs will not be characterized because either they are not feasible for treating bilgewater aboard Armed Forces vessels, or do not provide any significant environmental benefit over current practices (e.g., when bilgewater

is treated ashore). For further discussion, see the *Feasibility Impacts Analysis Report, for Surface Vessel Bilgewater* (Navy and EPA, 2002b).

1.2.2 Secondary Treatment

Secondary treatment MPCDs are used to treat effluent from a primary treatment system (e.g., oil/water separator effluent). Filter media and membrane filtration are feasible secondary treatment MPCDs for this discharge. Secondary MPCDs are MPCDs that are placed on a system after a primary treatment device to provide enhanced treatment capability.

1.3 CHARACTERIZATION DATA

1.3.1 Physical Parameters

Physical parameters of the discharge are characterized by the engineering data available for the representative vessel. Engineering data are derived from ship drawings and equipment specifications.

The term “discharge methods” refers to all manners in which bilgewater is released from the vessel either underway or pierside. Configuration parameters of the discharge port found on the representative vessel include port location (distance from discharge port to centerline and, approximate distance from the forward perpendicular to discharge port) and the discharge port diameter. These parameters are used in subsequent hydrodynamic modeling of the discharge. Additional parameters used for environmental effects modeling include release location, period, duration, temperature, salinity, linear velocity and flow rate of the liquid discharge. To accurately predict the transport of discharge constituents, a hydrodynamic model, CH3D, incorporated engineering parameters specific to the discharge and representative vessel. Modeling was performed to estimate a dilution factor as part of the HI analysis. The environmental effects modeling description and requirements are documented in the *Environmental Effects Analyses (EEA) Guidance for Phase II of the Uniform National Discharge Standards for Vessels of the Armed Forces* (Navy and EPA, 2000a) and *Technical Approach for Pierside Modeling to support UNDS EEA Phase II* (Navy and EPA, 2001b).

1.3.2 Constituent Data, Classical Data, and Other Descriptors

Multiple sources of data including sampling, process knowledge, and technical literature review were used to identify discharge constituents. Bilgewater/OWS sampling occurred during both UNDS Phase I and II. In Phase I, sampling was performed on USS JOHN C. STENNIS (CVN 74). Additional sampling was performed for Phase II on USS MAHAN (DDG 72), USS OAK HILL (LSD 51), USGC MORGENTHAU (WHEC 722), USS DAVID R. RAY (DD 971), USS BONHOMME RICHARD (LHD 6), USS CARNEY (DDG 64), and USS RUSHMORE (LSD 47). Further rationale for sampling is provided in the *UNDS Phase II Data/Information Collection and Sampling Needs Analyses* (Navy, 1999a).

1.3.2.1 Chemical Data

Chemical data are presented to document the observed chemical composition of the waste stream. The determination of constituents to be characterized for the bilgewater discharge is detailed in the Specified Sampling and Analysis Plan (SSAP). In most cases, concentrations of each constituent in the discharge were determined based on measurements of sample sets collected from the representative vessel. The reported concentration of each constituent was calculated as the log mean normal value of measured concentrations, with the following provisions: 1) laboratory or field measurements of a constituent concentration that were below the method detection limit were considered to be present at a concentration equal to the detection limit when at least one measurement from the sample set indicated a concentration greater than the detection limit; and 2) when all measurements for a constituent in a sample set were below the detection limit, that constituent was considered to be undetected (Kranacs, 1998). Final concentrations were determined similarly if the available data was based on process knowledge instead of sample data. The constituent concentrations and corresponding log mean normal values for each MPCD are located in the appendices.

1.3.2.2 Field Information

Field testing was performed on samples collected during Phase I and Phase II. Some tests were performed immediately following sample collection. These analyses, referred to as field tests, would be adversely affected by preservation methods. Parameters measured in the field, i.e., field data, include pH, temperature, salinity, specific conductance, and total and free chlorine. Additional characterization information on colloidal matter, color, floating materials, nuisance species, odor, settleable materials, total dissolved gases, transparency, and turbidity were collected for subsequent EEA evaluation of narrative water quality criteria.

Additional field testing was performed on the samples taken during the second round of sampling on the USS CARNEY and the USS RUSHMORE. The additional field testing was used to reduce uncertainty about whether narrative criteria are exceeded. The additional parameters evaluated included color (by determining color units), turbidity, dissolved oxygen, transparency, floating and settleable solids, foam, scum, and colloidal matter. Specific information concerning field testing is discussed in subsequent sections for each vessel group and MPCD.

1.3.2.1 Descriptive Information

Descriptive information for the discharge is also required for comparisons to narrative criteria endpoints. Categories of narrative criteria directly related to descriptive information include color, floating materials, odor, settleable materials, and turbidity/colloidal matter. As mentioned in Section 1.3.2.2, some of the descriptive data were obtained in the field during sampling using field tests and observations. Other data were obtained in the laboratory by observation or analysis. In many cases, specific tests were not performed for the narrative parameters; therefore, related results (e.g., total suspended solids may be used as an indication of turbidity) are used to provide some information concerning the narrative parameter. Specific information concerning descriptive information is evaluated for each vessel group and MPCD.

1.3.2.3 Discharge Generation Rates for Mass Loading

Annual generation volumes are necessary to determine annual mass loadings for the environmental effects analysis. The annual generation volume was determined for each vessel class within each vessel group. Generation rates per class were combined with the number of hulls within a class and vessel movement data to calculate annual volumes generated per vessel class. Vessel movement data includes information on the time a vessel spends in freshwater or saltwater as well as number of days in port, operating within 12 nm, and operating outside 12 nm. Vessels were divided into fresh- and saltwater groups prior to the calculation of their annual volumes. The summation of the annual volume per vessel class yielded the annual volume for the respective vessel groups.

1.4 UNCERTAINTY

Uncertainty analysis for this discharge addresses naturally occurring variability and parameter value accuracy for the representative vessel and applicable MPCDs. The Characterization Data Uncertainty Sections for the baseline discharge and each MPCD treated discharge include uncertainty analyses related to the physical parameters, constituent data, classical data, and other descriptors. For physical parameters (e.g., discharge port diameter), discussion of uncertainty does not focus on data variability, but rather on the assumptions used to identify parameter values.

There is wide variability in bilgewater composition and generation rates because of many factors, including dissimilarity in the daily constituent sources (e.g., the occurrence of leakage), irregularity in processing rates, age of vessel and piping materials, and the random nature of equipment failures. Due to the large number of factors that contribute to the naturally occurring variability in bilgewater composition, and the paucity of information pertaining to these factors, a statistical analysis of constituent and classical data that accounts for each of the many factors is impractical. Therefore, sampling was conducted to take a “snapshot” of the bilgewater composition for the discharge to complement available process knowledge. Sources of uncertainty are identified and discussed for each type of data for each vessel group and MPCD.